REMARKS

Initially, Applicants hereby affirm the election of Group I, claim 1-10 (see, paragraph 3 of the Office Action).

In this Amendment, claims 1, 5 and 7 have been amended, claims 3, 4 and 11-20 canceled, and new claims 21-23 added. Care has been exercised to avoid the introduction of new matter. Specifically, claim 1 has been amended to incorporate the limitations of claims 3 and 4. In addition, claim 1 has been amended to recite that the polyester article (A) has been etched with an aqueous solution of sodium hydroxide to form fine irregularities in the surface thereof in accordance with the teachings of the specification at, for example, page 5, lines 10-14, page 15, lines 20-24, page 16, lines 14-16, page 17, lines 20-23, page 28, lines 5-14 and *et seq*. Claims 5 and 7 have been amended to be dependent on claim 1, respectively. Adequate descriptive support for new claim 21 may be found in, for example, the present specification at page 17, lines 20-23. Adequate descriptive support for new claims 22 and 23 may be found in, for example, the present specification at page 23, lines 14-22.

Now, claims 1, 2, 5-10, and 21-23 are active in this application.

Claims 1-10 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Matsumura et al (US 4,369,207) in view of Nakamura et al (US 4,664,983).

It is noted that the rejection of claims 3 and 4 has been rendered moot by cancellation of these claims, as set forth above.

In paragraph 6 of the Office Action, the Examiner stated that "Matsumura et al. disclose a radiation crosslinked polyester article comprising saturated linear polyester... and a radiation crosslinkable polyfunctional monomer, wherein the polyester is metal plated... and wherein the

polyester article optionally contains fillers." The Examiner asserted that "Nakamura et al. disclose that it is well known in the art to incorporate 5-250 parts by weight of inorganic particle filler having typical particle sizes of 0.5-10 microns in polyester resins in order to reduce warpage and improve adhesion to plated metal layers while producing a smooth metal surface having a roughness of 0.8 microns after plating." The Examiner also asserted that "the reference further discloses that it is well known in the art to incorporate additives such as a brominated flame retardant in said polyester."

The Examiner concluded that "it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate crosslink a polyester substrate prior to plating and incorporate effective amounts of known additives in order to improve mechanical properties and dimensional stability." Furthermore, the Examiner asserted that "[o]ne of ordinary skill in the art would have also selected the polyester composition and adjusted the amount of crosslinking to obtain the intercomponent adhesion (claim 1) and thermal dimensional stability (claim 2) required for specific applications." This rejection is respectfully traversed.

In response, Applicants submit the applied combination of Matsumura et al. and Nakamura et al. does not teach a plated-polyester article including all the limitations recited in claim 1, as amended.

More particularly, a plated-polyester article in claim 1 comprises a polyester article (A) and a plating layer (B) formed on the surface of the article. The polyester article (A) is irradiated with ionizing radiation to crosslink a polyester resin. The polyester article (A) is an article obtained by melt-molding a resin composition with an inorganic filler selected from the group consisting of calcium pyrophosphate, crushed silica and spherical silica having an average particle diameter of 1 to 10 μm dispersed in a proportion of 5 to 20 vol.% in a polyester resin

crosslinkable by irradiation with ionizing radiation, and has been irradiated with ionizing radiation to crosslink the polyester resin. The polyester article (A) has been etched with an aqueous solution of sodium hydroxide to form fine irregularities in the surface thereof. The arithmetic mean roughness Ra of the surface of the plating layer (B) is at most 1 μm, and adhesion strength between the polyester article (A) and the plating layer (B) is at least 2 MPa.

Matsumura et al. disclose a laminated film structure composed of a polyester film and an electroconductive metal layer laminated to at least one surface of the polyester film, wherein the polyester film is an unstretched film of a cured aromatic polyester having a crosslinking degree of not less than 70%, a swelling degree of not more than 30 and an elongation at room temperature of not less than 10%.

Matsumura et al. further describe that "[i]t is also possible to use a combination of electroless plating and electroplating in the formation of an electroconductive metal layer, especially a copper layer, on the cured polyester film" (column 9, lines 13-17).

Particularly, Matsumura et al. describe as follows:

> The laminate film structure can also be produced by forming the conductive metal layer by electroless plating. For example, a copper layer can be formed on the cured polyester film by activating the surface of the cured polyester film by a known method, and then dipping the film in an electroless copper plating bath. A copper layer having a thickness of less than about 10 microns can be formed by electroless plating alone. If a thicker copper layer is required, electroplating is performed to the desired thickness after the electroless plating. In order to increase the adhesion of the polyester film to the copper foil, it is preferred to perform soft etching, such as treatment with amines, on the film.

Column 9, lines 54-66 of Matsumura et al. More specifically, in Example 6, Matsumura et al. disclose as follows:

> EXAMPLE 6
>
> Polybutylene terephthalate (intrinsic viscosity 0.70) was melted in an extruder, and a mixture of triallyl cyanurate and benzophenone (weight ratio 6:1) as a crosslinking agent was introduced into the extruder from a side pipe provided

> therein for blending of the crosslinking agent. Thus, the polybutylene terephthalate was mixed in the extruder with triallyl cyanurate and benzophenone. The mixture was extruded from a T-die, and quenched to afford a transparent film having a thickness of about 100 microns. The film was then subjected to the irradiation of light from a 2 KW high-pressure mercury lamp (30 W/cm) at a distance of 20 cm at 130°C for 5 minutes to form a cured film having a crosslinking degree of 95%, a swelling degree of 1.5 and an elongation at room temperature of 50%. The cured film was dipped for 1 minute in a 50% aqueous solution of monoethylamine at room temperature, and washed with water. The film was further dipped for 10 minutes in HS-101B (a sensitizer for electroless copper plating, a product of Hitachi Chemical Co., Ltd.), and washed with water. Furthermore, it was dipped for 5 minutes in ADP-201 (a bonding promoter, a product of Hitachi Chemical Co., Ltd.) and washed with water. Subsequently, the film was dipped at 25°C for 15 minutes in an electroless copper plating bath (CUST-201), washed with water, and then subjected to copper electroplating using a copper sulfate bath. There was obtained a laminate film copper-clad on both surfaces and having a copper layer thickness of about 30 microns. In the laminated film, the delamination strength in the 180° direction of the copper layer was 0.9 kg/cm. When it was subjected to a solder resistance test at 260°C for 30 seconds, no change was noted in the laminated film.

Column 14, line 65 to column 15, line 30 of Matsumura et al.

Applicants emphasize that a plated-polyester article in claim 1 is significantly different from the plated-laminated film of Matsumura et al.

First, there is no disclosure in Matsumura et al. relating to a polyester article obtained by melt-molding a resin composition with an inorganic filler selected from the group consisting of calcium pyrophosphate, crushed silica and spherical silica having an average particle diameter of 1 to 10 μm dispersed in a proportion of 5 to 20 vol.% in a polyester resin crosslinkable by irradiation with ionizing radiation, and has been irradiated with ionizing radiation to crosslink the polyester resin, as claimed.

Matsumura et al. merely describe that "[r]einforcing materials such as glass fibers, mica or talc may be included in the polyester film..." (column 8, lines 43-45).

According to claim 1, the inorganic filler selected from the group consisting of calcium pyrophosphate, crushed silica and spherical silica having an average particle diameter of 1 to 10 μm is employed to be incorporated into the polyester article.

Among various fillers, calcium pyrophosphate, ground silica and spherical silica are preferred from the viewpoints of melt-flowability of the resulting resin composition and mechanical strength of the resulting article.

The average particle diameter of the inorganic filler is 1 to 10 μm. If the average particle diameter of the inorganic filler is too small, such inorganic filler tends to aggregate in the polyester resin, so that surface roughness after the surface of the resulting article is subjected to an etching treatment is liable to be rather rough. When the inorganic filler aggregates in the polyester resin, the surface roughness Ra of the plating layer exceeds 1 μm, so that it is difficult to conduct wire bonding. Further, if the average particle diameter of the inorganic filler is too small, the adhesion strength of the plating layer becomes small even when the surface roughness Ra of the plaiting layer can be controlled to 1 μm or small. If the average particle diameter of the inorganic filler is too large on the other hand, the surface roughness Ra of the plaiting layer exceeds 1 μm, and the wire-bonding ability thereof is deteriorated.

The amount of the inorganic filler added is 5 to 20 vol.% based on the total volume of the resin composition. If the proportion of the inorganic filler added is too small, the adhesion strength between the resulting article and the plating layer is lowered. If the proportion is too large, surface roughness after the surface of the resulting article is subjected to an etching treatment becomes great. As a result, the surface roughness Ra of the plaiting layer exceeds 1 μm, and the wire-bonding ability thereof is deteriorated.

The polyester resin crosslinkable by irradiation with ionizing radiation does not rapidly lower its melt viscosity unlike the LCP even when it is heated in a molten state, and so the inorganic filler can be uniformly dispersed by the shearing force upon the melt mixing. As a result, irregularities of the size corresponding to the particle diameter of the inorganic filler dispersed can be formed in the surface of the article by etching. Therefore, the surface roughness Ra of the plating layer formed thereon is greatly improved compared with the LCP article, and moreover the adhesion strength of the plating layer becomes high.

In other words, according to the present invention, there can be provided a plated-polyester article having, in combination, both properties that the arithmetic mean roughness Ra of a plating layer is at least 1 μm, and the adhesion strength between the article and the plating layer is at least 2 MPa.

Second, Applicants found no specific teaching of Matsumura et al. relating to a polyester article which has been etched with an aqueous solution of sodium hydroxide to form fine irregularities in the surface thereof.

Matsumura et al. merely describe that "[i]n order to increase the adhesion of the polyester film to the copper foil, it is preferred to perform soft etching, such as treatment with amines, on the film" (column 9, lines 64-66). In Example 6 of Matsumura et al, "[t]he cured film was dipped for 1 minute in a 50% aqueous solution of monoethylamine at room temperature, and washed with water" (column 15, lines 12-15). Thus, Matsumura et al. teach performing soft etching of the polyester film under very moderate conditions.

However, under such soft etching conditions, the adhesion strength between the resulting article and the plating layer is lowered. Matsumura et al. show that in the laminated film of Example 6, the delamination strength in the 180° direction of the copper layer was 0.9 kg/cm.

The delamination strength of 0.9 kg/cm is extremely low level, and lower than the delamination strength of 1.2 kg/cm in Comparative Example 1 of Matsumura et al. (see TABLE 1).

According to claim 1, by etching with an aqueous solution of sodium hydroxide, irregularities of the size corresponding to the particle diameter of the inorganic filler dispersed can be formed in the surface of the article. In Examples disclosed in the specification of this application, the plate sample was immersed for 12 minutes in a 45% aqueous solution of sodium hydroxide at 85°C to etch it. The inorganic filler is selected from the group consisting of calcium pyrophosphate, crushed silica and spherical silica having an average particle diameter of 1 to 10 μm dispersed in a proportion of 5 to 20 vol.% in a polyester resin crosslinkable by irradiation with ionizing radiation. As a result, there can be provided a plated-polyester article having, in combination, both properties that the arithmetic mean roughness Ra of a plating layer is at least 1 μm, and the adhesion strength between the article and the plating layer is at least 2 MPa.

Thus, Matsumura et al. do not teach a plated-polyester article wherein the arithmetic mean roughness Ra of a plating layer is at least 1 μm, and the adhesion strength between the article and the plating layer is at least 2 MPa.

Nakamura et al. disclose a metal-plated molding comprising an extrusion molded or injection molded polyester composition which comprises 100 parts by weight of thermoplastic polyester and about 30 to 100 parts by weight of an oxide having a mean particle diameter of 0.5 to 10 μm. The oxide is selected from the group consisting of titanium dioxide and aluminum oxide. The molding has a metal plate surface.

However, Applicants found no teaching or suggestion by Nakamura et al. regarding a molded polyester composition obtained by melt-molding a resin composition with an inorganic

filler selected from the group consisting of calcium pyrophosphate, crushed silica and spherical silica having an average particle diameter of 1 to 10 μm dispersed in a proportion of 5 to 20 vol.% in a polyester resin crosslinkable by irradiation with ionizing radiation, and has been irradiated with ionizing radiation to crosslink the polyester resin, as claimed.

The metal-molding according to Nakamura et al. is not a polyester article irradiated with ionizing radiation to crosslink a polyester resin. The thermoplastic polyester such as poly (butylene terephthalate) employed by Nakamura et al. is not a crosslinkable polyester resin. Accordingly, the metal-molding of Nakamura et al. does not have good reflow resistance.

Nakamura et al. describe thermal cycle test of plating under the conditions that the specimen was subjected to three cycles of the exposure to 100°C. (1 hr.) and -30°C. (1 hr.) and 130°C. (1 hr.) and -30°C. (1 hr.) (column 10, lines 6-12). Thus, the thermal cycle test has been conducted under extremely low temperature conditions.

In contrast, the plated-polyester article of claim 1 has reflow resistance that the rates of changes in dimensions as measured under conditions that it is passed through a zone preset to 260°C in a reflow oven in 60 seconds is at most 1% in both longitudinal and crosswise directions.

In addition, claim 1 provides a plated-polyester article wherein the arithmetic mean roughness Ra of a plating layer is at least 1 μm, and the adhesion strength between the article and the plating layer is at least 2 MPa.

Nakamura et al. neither teach nor suggest an inorganic filler selected from the group consisting of calcium pyrophosphate, crushed silica and spherical silica having an average particle diameter of 1 to 10 μm.

As described above, Matsumura et al. also neither teach nor suggest an inorganic filler selected from the group consisting of calcium pyrophosphate, crushed silica and spherical silica having an average particle diameter of 1 to 10 μm. Furthermore, Matsumura et al. merely teach performing soft etching on the polyester film.

It is, therefore, submitted that the applied combination of Matsumura et al. and Nakamura et al. does not teach a plated-polyester article including all the limitations recited in claim 1, as amended, within the meaning of 35 U.S.C. §103. Dependent claims 2 and 5-10 are also patentably distinguishable over Matsumura et al. and Nakamura et al. al least because these claims respectively include all the limitations recited in independent claim 1. Applicants, therefore, respectfully solicit withdrawal of the rejection of claims 1, 2 and 5-10 and favorable consideration thereof.

New Claims 21-23

Applicants submit that new claims 21-23 are patentably distinguishable over Matsumura et al. and Nakamura et al. at least because these claims respectively include all the limitations recited in independent claim 1. Favorable consideration is respectfully solicited.

Conclusion

It should, therefore, be apparent that the imposed rejections have been overcome and that all pending claims are in condition for immediate allowance. Favorable consideration is, therefore, respectfully solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper,

including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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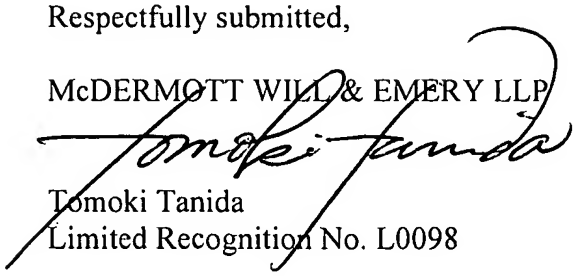

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